

011670.00006

PATENT

I. Amendments to the Claims

The following listing of the claims will replace all prior versions and listings of the claims in the reissue application.

Listing of the Claims

Claim 1. (original) In a system serially including a compressor, a discharge line, a condenser, an expansion device, an evaporator and a suction line, means for achieving capacity control comprising:

a solenoid valve in said suction line;

means for rapidly pulsing said solenoid valve whereby the rate of flow in said suction line to said compressor is modulated;

a fluid path extending from a point intermediate said condenser and said expansion device to said compressor at a location corresponding to an intermediate point of compression in said compressor;

a bypass line connected to said fluid path and said suction line;

a solenoid valve in said bypass line;

means for rapidly pulsing said solenoid valve in said bypass line whereby the rate of flow of bypass to said suction line is modulated.

Claim 2. (original) The capacity control of claim 1 further including;

an economizer circuit connected to said fluid path;

a solenoid valve in said economizer circuit; and

means for rapidly pulsing said solenoid valve in said economizer circuit whereby the rate of economizer flow to said compressor is modulated.

Claim 3. (original) In a system serially including a compressor, a discharge line, a condenser, an expansion device, an evaporator and a suction line, means for achieving capacity control comprising:

a solenoid valve in said suction line;

Supplemental Response

US 09/921,334

Reissue of U.S. Application 6,047,556

Page 2 of 11

011670.00006

PATENT

means for rapidly pulsing said solenoid valve whereby the rate of flow in said suction line to said compressor is modulated;

a fluid path extending from a point intermediate said condenser and said expansion device to said compressor at a location corresponding to an intermediate point of compression in said compressor;

an economizer circuit connected to said fluid path;

a solenoid valve in said economizer circuit; and

means for rapidly pulsing said solenoid valve in said economizer circuit whereby the rate of economizer flow to said compressor is modulated.

Claim 4. (previously presented) An air conditioning or refrigeration system comprising:

an evaporator;

a compressor;

a refrigeration fluid suction line from the evaporator to the compressor; and

a suction line valve, in the refrigeration fluid suction line, being cyclable between open and closed positions, the suction line valve in the closed position in normal operation preventing refrigeration fluid flow to the compressor other than optionally permitting a limited refrigeration fluid flow through the suction line valve to prevent vacuum pump operation.

the suction line valve operative to cycle with a cycling time shorter than the response time of the system to modulate compressor capacity.

Claim 5. (previously presented) The air conditioning or refrigeration system of claim 4 further comprising a capacity controller operative to generate a control signal corresponding to desired capacity modulation and operatively connected to the valve to send capacity control signals to cycle the valve with a cycling time shorter than the response time of the system to modulate compressor capacity.

Claim 6. (previously presented) The air conditioning or refrigeration system of claim 4 wherein the valve is cycled between a fully open and a fully closed position.

Supplemental Response

US 09/921,334

Reissue of U.S. Application 6,047,556

Page 3 of 11

011670.00006

PATENT

Claim 7. (previously presented) The air conditioning or refrigeration system of claim 5 wherein the controller comprises a microprocessor.

Claim 8. (previously presented) The air conditioning or refrigeration system of claim 4 wherein the valve is a solenoid valve.

Claim 9. (previously presented) An air conditioning or refrigeration system comprising:

an evaporator;

a compressor;

a refrigeration fluid suction line from the evaporator to the compressor, the refrigeration fluid suction line operative to carry refrigeration fluid from the evaporator to the compressor;

a capacity controller operative to generate a control signal corresponding to desired capacity modulation; and

a suction line valve, in the refrigeration fluid suction line, operatively connected to the controller to receive capacity control signals from the controller and being cyclable between open and closed positions, the suction line valve in the closed position in normal operation preventing refrigeration fluid flow to the compressor other than optionally permitting a limited flow through the suction line valve to prevent vacuum pump operation.

the suction line valve operative in response to capacity control signals received from the controller to cycle with a cycling time shorter than the response time of the system to modulate compressor capacity.

Claim 10. (previously presented) The system of claim 9 wherein the valve is cycled between a fully open position and a fully closed position.

*Supplemental Response
US 09/921,334
Reissue of U.S. Application 6,047,556
Page 4 of 11*

011670.00006

PATENT

Claim 11. (previously presented) The system of claim 9 wherein the system capacity controller comprises a microprocessor.

Claim 12. (previously presented) The system of claim 9 wherein the valve is a solenoid valve.

Claim 13. (previously presented) The system of claim 10 wherein the valve in the fully closed position permits a limited fluid flow through the refrigerant flow line.

Claim 14. (previously presented) An air conditioning or refrigeration system comprising:

an evaporator;

a compressor;

a refrigeration fluid suction line from the evaporator to the compressor, the refrigeration fluid suction line operative to carry refrigeration fluid from the evaporator to the compressor;

a capacity controller operative to generate a control signal corresponding to desired capacity modulation; and

a solenoid valve, in the refrigeration fluid suction line, operatively connected to the controller to receive capacity control signals from the controller and being cyclable between open and closed positions, the solenoid valve in the closed position in normal operation preventing refrigeration fluid flow to the compressor other than optionally permitting a limited flow through the solenoid valve to prevent vacuum pump operation,

the solenoid valve operative in response to capacity control signals received from the controller to cycle between a fully open position and a fully closed position to modulate compressor capacity.

Claim 15. (previously presented) The system of claim 14 wherein the system capacity controller comprises a microprocessor.

Supplemental Response

US 09/921,334

Reissue of U.S. Application 6,047,556

Page 5 of 11

011670.00006

PATENT

Claim 16. (previously presented) The system of claim 14 wherein the solenoid valve in the fully closed position permits a limited fluid flow through the refrigerant flow line.

Claim 17. (previously presented) A capacity modulated compressor for an air conditioning or refrigeration system comprising:

a compressor housing comprising a compression chamber, a refrigeration fluid suction line operative to pass refrigerant to the compression chamber, and at least one refrigerant discharge line operative to pass compressed refrigerant from the compression chamber;

a capacity controller operative to generate a control signal corresponding to desired capacity modulation; and

a suction line valve, in the refrigeration fluid suction line, operatively connected to the controller to receive capacity control signals from the controller and being cyclable between open and closed positions, the suction line valve in the closed position in normal operation preventing refrigeration fluid flow to the compression chamber other than optionally permitting a limited flow through the suction line valve to prevent vacuum pump operation,

the suction line valve operative in response to capacity control signals received from the controller to cycle with a cycling time shorter than the response time of the system to modulate compressor capacity.

Claim 18. (previously presented) The compressor of claim 17 wherein the valve is cycled between a fully closed position and a fully open position.

Claim 19. (currently amended) The compressor of claim 17 wherein the valve is disposed in a refrigerant flow line upstream with respect to refrigerant flow to at least one refrigerant injection port.

Claim 20. (cancelled)

*Supplemental Response
US 09/921,334
Reissue of U.S. Application 6,047,556
Page 6 of 11*

011670.00006

PATENT

Claim 21. (previously presented) The compressor of claim 17 wherein the system capacity controller comprises a microprocessor.

Claim 22. (previously presented) The compressor of claim 17 wherein the valve is a solenoid valve.

Claim 23. (previously presented) The compressor of claim 18 wherein the valve in the fully closed position permits a limited fluid flow through the refrigerant flow line.

Claim 24. (previously presented) A capacity modulated compressor for an air conditioning or refrigeration system comprising:

a compressor housing comprising a compression chamber, at least one refrigerant suction line operative to pass refrigerant to the compression chamber and at least one refrigerant discharge line operative to pass compressed refrigerant from the compression chamber;

a capacity controller operative to generate a control signal corresponding to desired capacity modulation; and

a solenoid valve, in the refrigeration fluid suction line, operatively connected to the controller to receive capacity control signals from the controller and being cyclable between open and closed positions, the solenoid valve in the closed position in normal operation preventing refrigeration fluid flow to the compression chamber other than optionally permitting a limited flow through the solenoid valve to prevent vacuum pump operation,

the solenoid valve operative in response to capacity control signals received from the controller to cycle between a fully open position and a fully closed position to modulate compressor capacity.

011670.00006

PATENT

Claim 25. (currently amended) The compressor of claim 24 wherein the solenoid valve is disposed in a refrigerant flow line upstream with respect to refrigerant flow to at least one refrigerant injection port.

Claim 26. (cancelled)

Claim 27. (previously presented) The compressor of claim 24 wherein the system capacity controller comprises a microprocessor.

Claim 28. (previously presented) The compressor of claim 24 wherein the solenoid valve in the fully closed position permits a limited fluid flow through the refrigerant flow line.

Claim 29. (previously presented) A capacity modulated compressor comprising:
a compressor having a refrigeration fluid suction line for supplying refrigeration fluid to the compressor;
a suction line valve provided in the suction line to the compressor, the suction line valve being operable between open and closed positions to cyclically allow and prevent flow of refrigeration fluid into the compressor, the suction line valve in the closed position in normal operation preventing refrigeration fluid flow to the compression chamber other than optionally permitting a limited refrigeration fluid flow through the suction line valve to prevent vacuum pump operation;
a controller for actuating the suction line valve between the open and closed positions, the controller being operative to cycle the suction line valve such that its cycle time is shorter than the response time of the system to modulate compressor capacity.

Claim 30. (previously presented) The capacity modulated compressor of claim 29 wherein the valve is positioned in close proximity to the compressor.

*Supplemental Response
US 09/921,334
Reissue of U.S. Application 6,047,556
Page 8 of 11*

011670.00006

PATENT

Claim 31. (previously presented) The capacity modulated compressor of claim 29 wherein the valve is a bi-directional valve.

Claim 32. (previously presented) The capacity modulated compressor of claim 29 wherein the valve is a solenoid valve.

E
Claim 33. (previously presented) A method of modulating the capacity of a compressor in an air conditioning or refrigeration system, comprising cycling a suction line valve, in fluid communication with the compressor, using a cycle time shorter than the response time of the system to modulate compressor capacity, the suction line valve being operable between open and closed positions to cyclically allow and prevent flow of refrigeration fluid into the compressor, the suction line valve in the closed position in normal operation preventing refrigeration fluid flow to the compression chamber other than optionally permitting a limited refrigeration fluid flow through the suction line valve to prevent vacuum pump operation.

Claim 34. (previously presented) The method of claim 33 wherein the valve is a solenoid valve.

Claim 35. (previously presented) A method of modulating the capacity of a compressor in a closed refrigerant circulating system, said compressor comprising a compression chamber in fluid communication with a refrigerant suction line of the system through which refrigerant fluid is supplied to the compression chamber, comprising:

rapidly cycling a solenoid valve, disposed in the refrigerant suction line upstream of said compression chamber, between its fully open position and its fully closed position to modulate compressor capacity, the solenoid valve in the closed position in normal operation preventing refrigeration fluid flow to the compression chamber other than optionally permitting a limited refrigeration fluid flow through the solenoid valve to prevent vacuum pump operation.

*Supplemental Response
US 09/921,334
Reissue of U.S. Application 6,047,556
Page 9 of 11*

011670.00006

PATENT

Claim 36. (previously presented) The method of claim 35 wherein rapidly cycling said solenoid valve comprises cycling the solenoid valve with a cycling time shorter than the response time of the system to modulate compressor capacity.

E
Claim 37. (previously presented) The method of claim 35 wherein said cycling controls the percentage of time said solenoid valve is fully open to refrigerant flow therethrough to the compression chamber.

Claim 38. (previously presented) The method of claim 35 wherein said cycling is controlled by a microprocessor.

-THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK-